SOUTHERN OXIDANTS STUDY

Questions and Answers About Ozone Pollution

June-July 1999

What is ozone?

Ozone is a gas that is formed in the atmosphere when three atoms of oxygen combine. Naturally occurring ozone is found in two major places:

- High in the atmosphere, far from the earth's surface, naturally occurring ozone is formed when intense sunlight causes oxygen molecules (O_2) to break up and re-form as unstable O_3 molecules. This stratospheric ozone, popularly called "good ozone," provides a shield that protects people, trees, crops, property, and microorganisms from the harmful effects of the sun's ultraviolet light.
- Low in the atmosphere, near the ground where people live and trees and crops grow, naturally occurring ozone also is formed when certain substances emitted by trees and other vegetation, soil microorganisms, and lightning react together to form low (background) concentrations of ozone.

If the ground-level ozone present in the air were produced only from natural sources of emissions, it would be of no concern. Both animal and plant life tolerate natural concentrations of ozone. But many contemporary human activities—transportation, energy production, and some industrial and commercial operations—involve emissions of additional chemical compounds (called precursors) that also react in the air to form ozone and other harmful gases.

GOOD UP HIGH

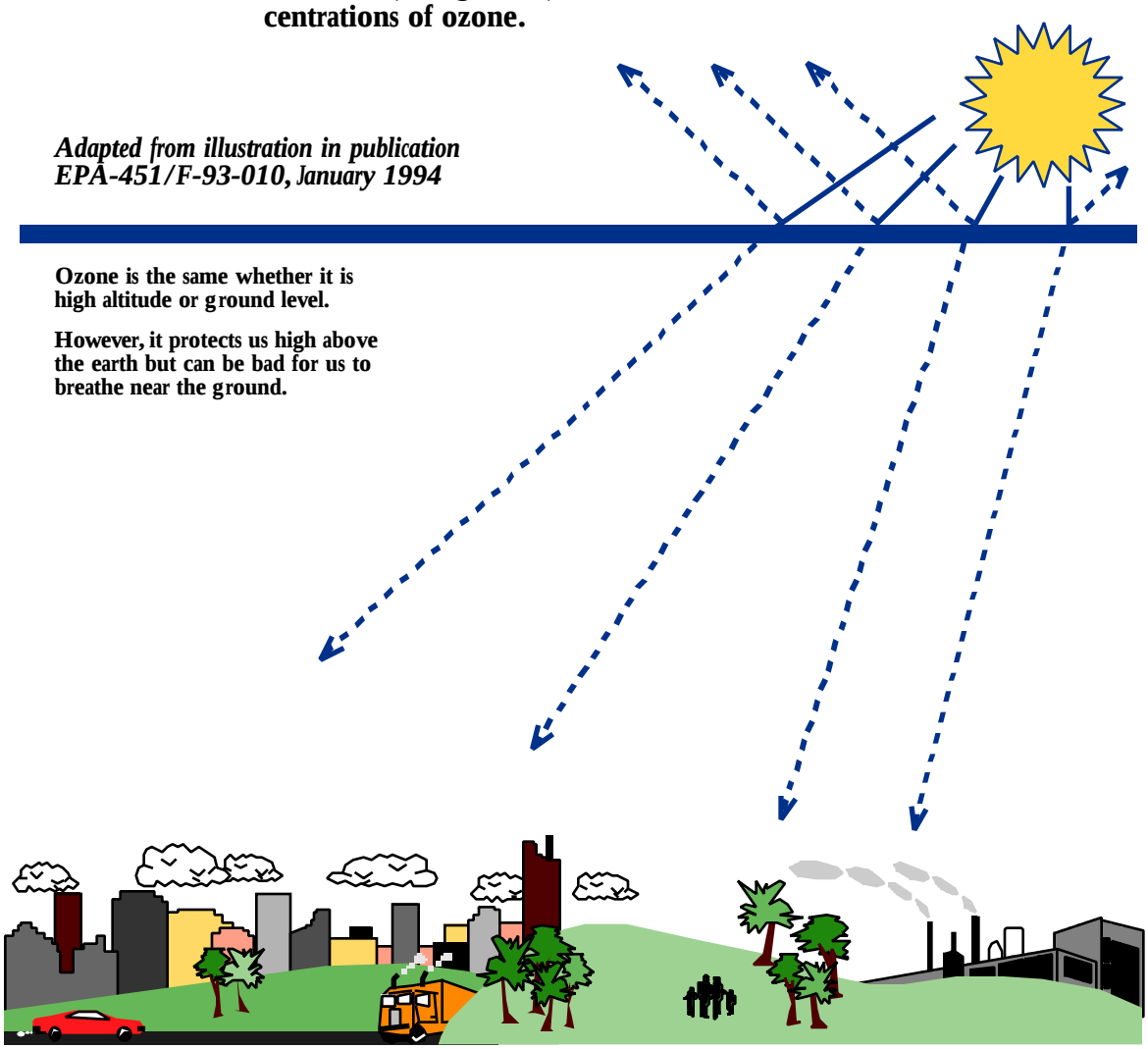
OZONE

BAD NEARBY

Adapted from illustration in publication EPA-451/F-93-010, January 1994

Ozone is the same whether it is high altitude or ground level.

However, it protects us high above the earth but can be bad for us to breathe near the ground.



What is ozone pollution and how does it occur?

Ozone pollution, commonly called smog or "bad ozone," occurs when unnaturally high concentrations of ozone accumulate near the ground.

Ozone is not emitted directly into the air, but there are chemical compounds which are emitted from both natural sources and human activities that react together to form ozone.

These reactions are driven by light energy from the sun. For this reason, ozone and other reaction products are collectively called "photochemical oxidants."

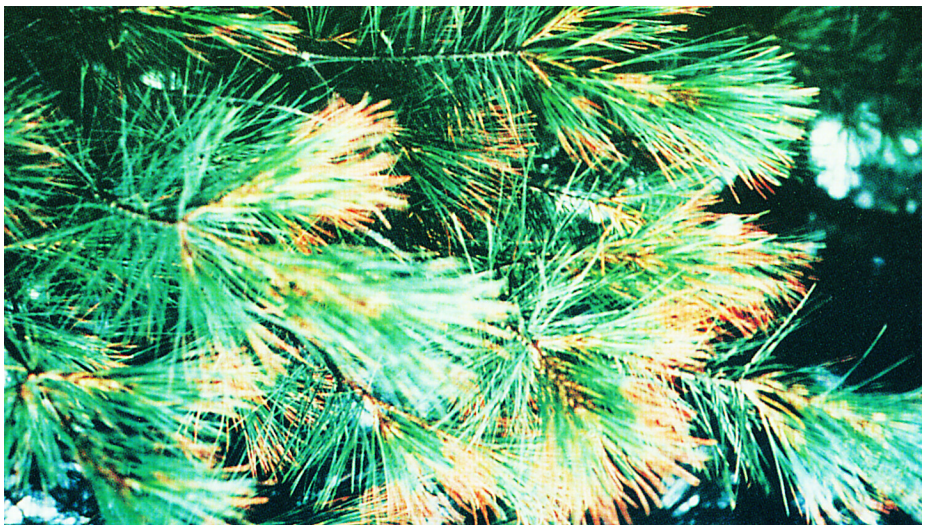
The major sources of ozone-producing emissions from human activities include cars, trucks, power plants and other industrial boilers, boats, airplanes, lawn mowers, printing companies, bakeries, painting and solvent cleaning operations, etc.

What causes ozone to accumulate in harmful concentrations near the ground?

The concentration of ozone in the air is determined not only by the amounts of ozone precursor chemicals but also by weather and climatic factors. Intense sunlight, warm temperatures, stagnant high-pressure weather systems, and low wind speeds cause ozone to accumulate in harmful amounts.

When and where does ozone pollution occur?

Ozone concentrations usually are greatest during daylight hours in the warmer summer months. In the South, ozone pollution occurs most frequently in large metropolitan areas such as Atlanta, Georgia, and Houston, Texas. But ozone pollution also occurs in smaller cities such as Nashville, Tennessee, and the Research Triangle area of North Carolina.



Needle-Tip Necrosis on White Pine
(Photo by Allen S. Heagle, North Carolina State University)

Bronzing on Pole Bean
(Photo by Allen S. Heagle, North Carolina State University)

Winds may also transport ozone and chemical emissions from one area to another. Average rural summertime ozone concentrations in the South are among the highest in North America. Thus, ozone pollution is not just an urban problem.

Why are people concerned about ozone pollution?

Ozone is a very reactive gas. For this reason, high concentrations of ozone can cause respiratory distress and disease in humans, decreased yields of agricultural crops and forests, and damage to some rubber products, plastics, and paints used outdoors.

Does ozone pollution near the ground pose a serious threat to people?

Yes, ozone pollution near the ground is the most widespread air quality problem in the United States.

Nearly 100 major cities in the United States are periodically exposed to concentrations of ozone that exceed health-based air quality standards. A significant number of those cities are in the South.

National crop losses from ozone exposure are estimated at $3 billion to $5 billion annually. Forest losses are harder to estimate.

In areas that exceed the National Ambient Air Quality Standard for ozone, federal and state governments must restrict industrial growth and expansion to protect the environment. But these restrictions also decrease economic opportunities for citizens who live in ozone non-attainment areas.

What is being done about ozone air pollution by scientists and government agencies?

In the United States, management of ozone and other photochemical oxidants has been a major goal of federal and state clean air legislation.The federal Clean Air Act (CAA) was passed in 1970. It was amended in 1977 and 1990. Under the authority of this Act, EPA requires each state to regulate emissions that contribute to ozone accumulation. Although many of the pollution control efforts required by the CAA have been implemented, efforts to decrease ozone pollution have been only partially successful.

A recent report by the National Academy of Science concluded that federal and state regulations and industry practices have largely failed to decrease ozone exposures. This is true not only in the South but also in other parts of the United States. For example, about $800 million has been spent on ozone reduction measures in the Atlanta metropolitan area, but average summertime ozone concentrations in Atlanta showed no significant change during the 1980s and into the 1990s.

Right: *Adapted from illustration of Clean Texas 2000, an environmental partnership program of the Texas Natural Resource Conservation Commission.*

IS THERE ANYTHING THE AVERAGE CITIZEN CAN DO?

Although sound environmental policies and regulations are essential for healthy air, the average citizen can assist. The illustration below lists some reminders that everyone can do to help improve air quality.

Do Your Share For Cleaner Air.

TEN THINGS YOU CAN DO:

1. PARTICIPATE IN YOUR COMMUNITY'S OZONE ADVISORY DAY ACTIVITIES.
2. RIDE THE BUS.
3. SHARE A RIDE TO WORK.
4. WALK OR RIDE A BICYCLE.
5. COMBINE YOUR TRIPS TO RUN ERRANDS.
6. TRY NOT TO OVER-COOL YOUR HOME.
7. TAKE QUICK SHOWERS.
8. AVOID LETTING YOUR ENGINE IDLE FOR TOO LONG—LIKE AT COMMERCIAL DRIVE-THRU LANES.
9. RUN DISHWASHERS AND WASHING MACHINES WITH ONLY A FULL LOAD.
10. KEEP YOUR VEHICLE PROPERLY TUNED TO KEEP EXHAUST LEVELS LOW.

Since substantial growth in the human population and vehicle use has occurred in Atlanta, it is encouraging that no significant increase in average ozone concentrations occurred. But it is also discouraging that no significant decrease in average ozone concentrations occurred during this same time period. Thus, the Academy of Sciences report called for significant rethinking of the ozone problem in urban and regional air pollution.

What new ozone management strategies are being disussed?

Many federal and state regulatory authorities and leaders in industry, commerce, and public interest groups, now agree that more scientific research on ozone accumulation near the ground will be needed if more cost-effective management strategies are to be developed. Some strategies being discussed include:

- More stringent NO_x standards for transportation vehicles, power plants, and other industrial boilers. In the past, NO_x has received much less attention than VOCs.
- Better methods to decrease evaporation of gasoline, solvents, and other VOCs into the atmosphere.
- More complete cooperation among land use planners, transportation planners, and air quality managers in developing new strategies for regional economic development and transportation systems.

WHY IS IT SO DIFFICULT TO MANAGE OZONE POLLUTION?

Ozone pollution has turned out to be a much more complicated problem than government and industry leaders originally anticipated. Therefore, more complete scientific information about the chemical, meteorological, transportation, energy production, and industrial commercial processes involved in ozone pollution is needed.

We know that ozone-precursor emissions include two types of reactive compounds–volatile organic compounds (VOCs) and nitrogen oxides (NO_x). VOCs are emitted mainly by cars, factories, and trees and other vegetation. NO_x compounds are emitted mainly by cars, power plants and other industrial boilers, well-fertilized soils, and lightning.

Some important research indudes:

- Determining where and when it is most effective to put control emphasis on VOC emissions as opposed to control emphasis on NO_x emissions.
- Determining what percentage of ozone measured in an ozone non-attainment area is formed locally and what part is imported from more distant parts of the region.
- Developing better methods of estimating VOC and NO_x emissions from all types of sources (cars, factories, power plants, nature, etc.).
- Testing the accuracy of models commonly used in developing State Implementation Plans to meet the National Ambient Air Quality Standard for ozone.
- Developing new and improved scientific models showing how ozone pollution occurs.
- It now appears that some areas of the United States have unique mixes of meteorological and climatic factors, as well as both natural and manmade sources of VOCs and NO_x. Therefore, successful ozone control strategies may need to be tailored more specifically to a given region or urban area.

What is the Southern Oxidants Study?

The Southern Oxidants Study (SOS) is a strategic alliance of research scientists, engineers, and air quality managers from universities, federal and state governments, industry, and public interest groups.

In SOS, these groups work to design and execute scientific research and modeling programs that will increase present understanding of ozone accumulation in the atmosphere.

The SOS research program began in 1988 and includes:

- Continuous monitoring of regional ozone concentrations, weather and climatic factors, and ozone precursor concentrations.
- Periodic intensive studies of ozone concentrations, ozone precursor concentrations, and weather factors in selected urban ozone non-attainment areas in the South. The first SOS urban intensive study was conducted in the Atlanta metropolitan area in 1992. SOS urban intensive studies have also taken place in the Nashville/Middle Tennessee area in 1994-95.

WHAT ARE THE SCIENTIFIC GOALS OF THE SOUTHERN OXIDANTS STUDY?

- To improve scientific and public understanding of the chemical and meteorological processes that cause ozone and other photochemical oxidants to accumulate in the atmosphere near the ground.
- To evaluate ways in which leaders of various federal, state, municipal, industrial, and commercial organizations can help manage accumulations of ozone and other photochemical oxidants in the atmosphere, thus decreasing the effects of ozone pollution in various urban and rural areas in the southern United States.

Who participates in the Southern Oxidants Study?

Government/Industries

U. S. Environmental Protection Agency
Electric Power Research Institute
National Oceanic and Atmospheric Administration
U. S. Department of Energy
Tennessee Valley Authority
EPA Regions 4 and 6
Coordinating Research Council of the automobile and petroleum industries
Southern Company
Duke Power Company
Georgia Power
National Park Service
DuPont Chemicals
Environmental Science and Engineering, Inc.
National Center for Atmospheric Research
SAIC/The Fleming Group
National Aeronautic and Space Administration

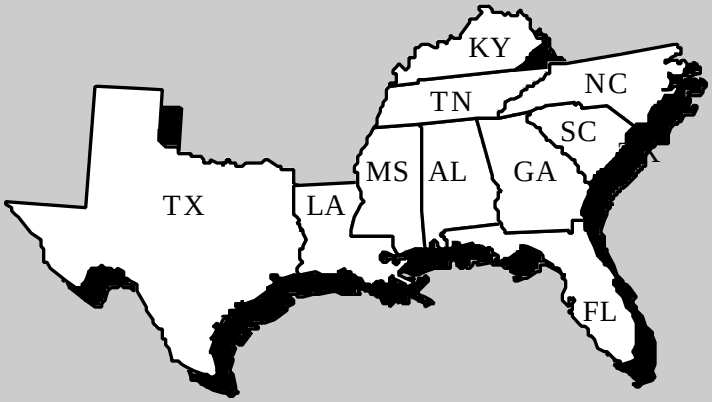
States

Georgia
Tennessee
Alabama
Kentucky
North Carolina
South Carolina
Florida
Mississippi
Louisiana
Texas

Universities

Georgia Institute of Technology
North Carolina State University
University of Alabama-Huntsville
University of Miami
University of Michigan
University of Tennessee-Knoxville
Western Michigan University
Purdue University

The Southern Oxidants Study region includes 10 states.



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